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ABSTRACT

Reported are development, implementation and results of a 6 week summer training program in 1972 (funded through Title I) for 120 underachieving educable mentally handicapped children, 6 to 13 years of age, in St. Paul, Minnesota. Emphasized are learning processes and learning strategies in the daily instructional skills related to reading, arithmetic, functional vocabulary acquisition, and strategy training. Inservice training is reported as continuous, with instruction in the classroom led by five previously trained teachers. Described are instructional objectives, specific instructional approaches, and evaluation procedures (such as Stanford Achievement Tests, staff developed tests, and the Peabody Picture Vocabulary Test). Reported are results which show that children who completed 5 of 6 weeks achieved a gain of 1.57 months in reading, 1.98 months in arithmetic, and 4 months in vocabulary. Findings also describe most of the children as able to discover meaningful relations between categorically presented materials and a significant increase in percentage of children who used their grouping skills with good use of memory (mnemonic effect). The discussion centers on fallout from the program, such as procedures for integrating a processing approach to learning with curricular materials, effects of training children to generate stories and/or pictures for associating noncategorized stimuli, and new approaches to research and development. Touched upon briefly are such program limitations as insufficient time for teacher observational feedback. (MC)

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R. Hunt Riegel and Arthur M. Taylor
University of Minnesota

Research, Development and Demonstration
Center in Education of Handicapped Children
Minneapolis, Minnesota

March 1973

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3. R. Riegel & A. Taylor. A comparison of conceptual strategies for grouping and remembering employed by educable mentally retarded and non-retarded children. Research Report #46. February 1973.

4. J. Rynders. Two basic considerations in utilizing mothers as tutors of their very young retarded or potentially retarded children. Occasional Paper #12. January 1973.

5. R. Bruininks, J. Rynders, & J. Gross. Social acceptance of mildly retarded pupils in resource rooms and regular classes. Research Report #45. January 1973.

6. J. Turnure & M. Thurlow. The effects of interrogative elaborations in the learning of normal and EMR children. Research Report #44. January 1973.

7. J. Turnure & S. Samuels. Attention and reading achievement in first grade boys and girls. Research Report #43. November 1972.

8. R. Riegel, A. Taylor, S. Clarsen, & F. Danner. Training educationally handicapped children to use associative grouping strategies for the organization and recall of categorizable material. Research Report #42. November 1972.

9. R. Riegel, F. Danner, & A. Taylor. Steps in sequence: Training educationally handicapped children to use strategies for learning. Development Report #2. November 1972.

10. A. Taylor, M. Thurlow, & J. Turnure. The teacher's introduction to: the Math Vocabulary Program. Development Report #1. March 1973.

11. J. Turnure & M. Thurlow. The effects of structural variations in elaboration on learning in normal and EMR children. Research Report #41. September 1972.

12. A. Taylor & N. Bender. Variations of strategy training and the recognition memory of EMR children. Research Report #40. September 1972. (American Educational Research Journal, in press).

13. D. Moores, C. McIntyre, & K. Weiss. Evaluation of programs for hearing impaired children: Report of 1971-1972. Research Report #39. September 1972.

14. R. Rubin. Follow-up of applicants for admission to graduate programs in special education. Occasional Paper #11. July 1972.

15. D. Moores. Communication - Some unanswered questions and some unquestioned answers. Occasional Paper #10. July 1972.

16. A. Taylor & S. Whitely. Overt verbalization and the continued production of effective elaborations by EMR children. Research Report #38. June 1972. (American Journal of Mental Deficiency, in press).

17. R. Riegel. Measuring educationally handicapped children's organizational strategies by sampling overt groupings. Research Report #37. May 1972.

18. E. Gallistel, M. Boyle, L. Curran, & M. Hawthorne. The relation of visual and auditory aptitudes to first grade low readers' achievement under sight-word and systematic phonic instruction. Research Report #36. May 1972.

19. E. Gallistel & P. Fischer. Decoding skills acquired by low readers taught in regular classrooms using clinical techniques. Research Report #35. May 1972.

20. J. Turnure & M. Thurlow. Verbal elaboration in children: Variations in procedures and design. Research Report #34. March 1972.

21. D. Krus & W. Bart. An ordering-theoretic method of multidimensional scaling of items. Research Report #33. March 1972.

22. J. Turnure & S. Larsen. Effects of various instruction and reinforcement conditions on the learning of a three-position oddity problem by nursery school children. Research Report #32. March 1972.

23. J. Turnure & S. Larsen. Outerdirectedness in mentally retarded children as a function of sex of experimenter and sex of subject. Research Report #31. March 1972.

24. J. Rynders & J. Horrobin. A mobile unit for delivering educational services to Down's Syndrome (Mongoloid) infants. Research Report #30. January 1972. (Presented at Council for Exceptional Children, Special National Conference, Memphis, December, 1971).

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R. Hunt Riegel and Arthur M. Taylor
University of Minnesota

Research, Development and Demonstration
Center in Education of Handicapped Children
University of Minnesota
Minneapolis, Minnesota

March 1973

The research reported herein was performed pursuant to a grant from the Bureau of Education for the Handicapped, U. S. Office of Education, Department of Health, Education and Welfare to the Center for Research, Development and Demonstration in Education of Handicapped Children, Department of Special Education, University of Minnesota. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official position of the Bureau of Education for the Handicapped.

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RESEARCH AND DEVELOPMENT CENTER
IN EDUCATION OF HANDICAPPED CHILDREN
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The University of Minnesota Research, Development and Demonstration Center in Education of Handicapped Children has been established to concentrate on intervention strategies and materials which develop and improve language and communication skills in young handicapped children.

The long term objective of the Center is to improve the language and communication abilities of handicapped children by means of identification of linguistically and potentially linguistically handicapped children, development and evaluation of intervention strategies with young handicapped children and dissemination of findings and products of benefit to young handicapped children.

Foreword

An endeavor such as the project described herein requires the cooperative efforts of a number of individuals and systems in order to fully integrate a series of intervention strategies for young handicapped children. By far the most important figures in this summer program were the children, whose destinies were entrusted to our care for a brief time. It is important, however, that the proper recognition be given to those adults whose efforts have made the program successful. The St. Paul, Minnesota Public Schools administrators have been instrumental in encouraging our work, and in providing a core of excellent teachers to apply experimental materials in the classrooms. In particular, the support and interested cooperation of Charles Hagen, Charles Burbach, and Helen Arbes have contributed significantly to the feasibility of this program.

In addition, the lead teachers, who added an enthusiastic and creative dimension to the program, contributed to the maintanence of daily continuity, and provided ideas for the integration of specific content of the academic areas with the strategies approach. Nila Bender, Zella Cahill, Fred Danner, Ann DeGree, and Patricia Fernandez constituted this team of lead teachers, and are largely responsible for translating the language of the researchers into the language of the teachers, and back again.

The classroom teachers provided the program with its real foundation in their unflagging interest in the learning process and in their concern for the individual needs of every child they taught. This group included the following people, to whom we owe a great debt of thanks:

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Lynne Fisher
Dorothy Knight
Louise Knopick
Gloria Nozal
Clayton Qualley
Linda Rousseau
Colleen Wieteke
Lynn Wogen

We are grateful to the classroom aides and the secretaries whose interest and assistance was a source of much comfort to the entire staff. And finally, we would like to thank the administrators of the R,D&D Center for their support and interest in our endeavor. Don Moores and Jim Turnure have encouraged this project since its inception.

We believe that the program described in the following pages is the result of a truly cooperative venture into the realm of improving the learning conditions of handicapped children. Our understanding of the problems encountered by the children has been expanded, and our enthusiasm for continuing the line of inquiry which has led to applying strategies in the classroom has been fortified.

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Strategies in the Classroom: A Summer Remedial Program for Young Handicapped Children

R. Hunt Riegel and Arthur M. Taylor

University of Minnesota

This paper reports the development, implementation and results of a training program instituted for special remedial training of underachieving EMR children during a summer school program in 1972. The program, funding through the St. Paul Schools pursuant to a Title I U.S.O.E. grant, was conducted as a joint effort between the Special Education department of the St. Paul Schools and a group of researchers from the Research, Development and Demonstration Center in Education of Handicapped Children at the University of Minnesota. The purpose of this joint venture was twofold: first, to remediate specific academic deficiencies in the children admitted to the program, particularly in the areas of basic reading and math skills, and second to provide a framework with which new avenues for facilitating the children's acquisition of learning sets or "learning to learn" strategies could be explored and developed for future curricular recommendations. In this paper, we shall first review the characteristics of the program and the strategies approach which formed the basis for modification of existing curricular components. Following this, a review of the results of the summer training will be presented. A discussion of the implications of our findings will then be presented, focusing on (1) continued research in the area of training children how to learn, (2) proposing modifications in teacher-training approaches to the education of handicapped children,

and (3) the usefulness of the dual approach to remedial education, in which both researchers and practitioners cooperate in an effort to enhance the academic prognosis for young handicapped children.

General Description

This program was designed to serve 120 handicapped children who reside in Title I - eligible school attendance areas in St. Paul. The population was predominantly mentally retarded children, but included other handicapped pupils for whom the program was deemed appropriate. A single center was used, to which children were transported from all eligible attendance areas. The population included children previously enrolled in special schools, special class and special education resource or itinerant instruction programs who were judged by their teachers and principals to have a special need for a supplementary, remedial summer program. All pupils enrolled were at least one year below grade level, but those having first priority for enrollment were pupils who were two or more years below their expected level of achievement. Youngsters who were between the ages of 6 and 13 years were included. The average IQ of these children was 70.

The general orientation of the staff, being composed of both practitioners and researchers, was one in which the curricular and investigatory effort was shared according to a model articulated by Moores (1971). Figure 1 presents a graphic summary of the relative amount of responsibility of each of the groups, with specific strategy-based efforts indicated in the appropriate locations.

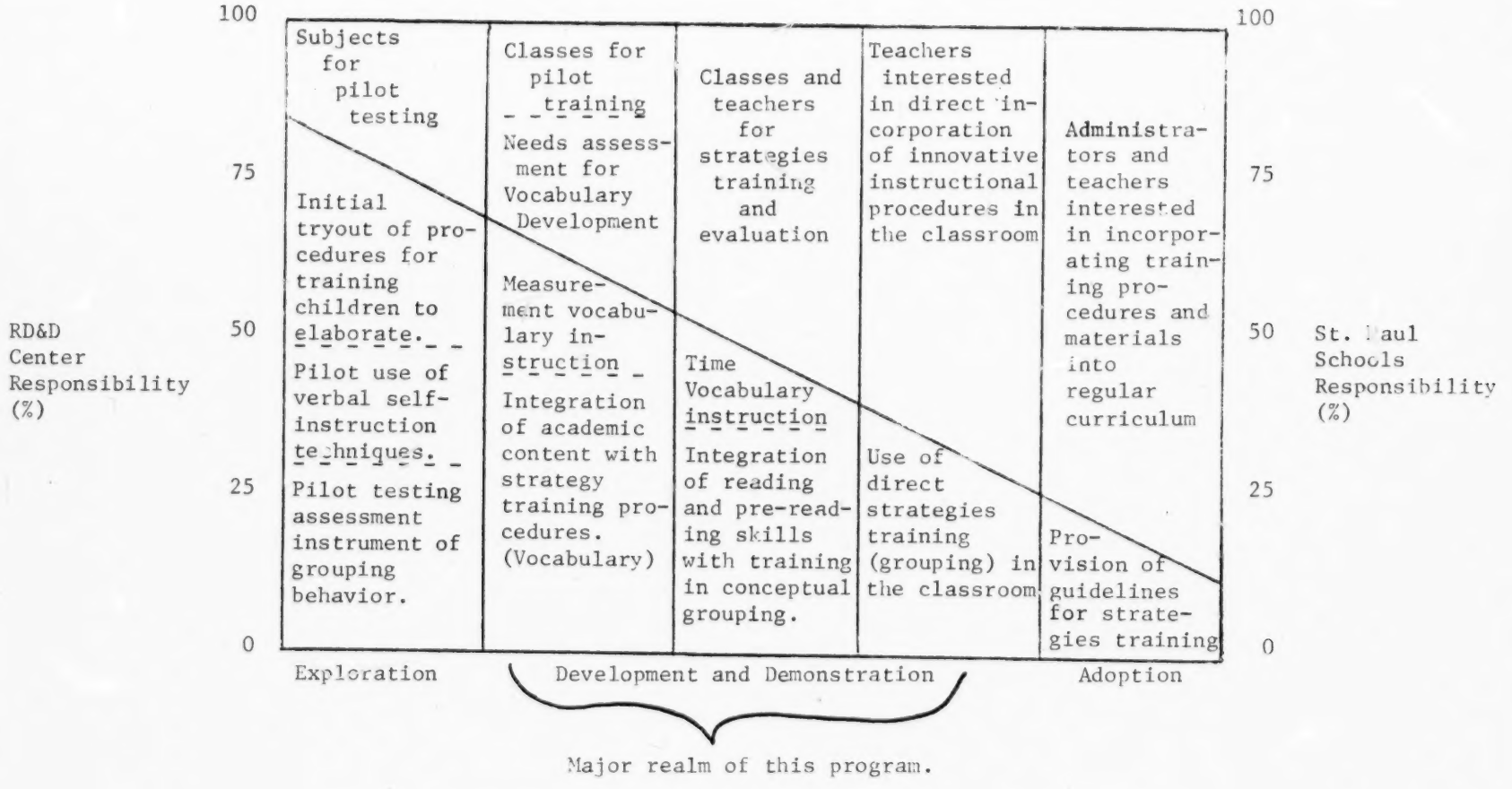
100
75
50
25
0
RD&D Center Responsibility (%)
Subjects for pilot testing
Initial tryout of procedures for training children to elaborate.
Pilot use of verbal self-instruction techniques.
Pilot testing assessment instrument of grouping behavior.
Classes for pilot training
Needs assessment for Vocabulary Development
Measurement vocabulary instruction
Integration of academic content with strategy training procedures. (Vocabulary)
Classes and teachers for strategies training and evaluation
Time Vocabulary instruction
Integration of reading and pre-reading skills with training in conceptual grouping.
Teachers interested in direct incorporation of innovative instructional procedures in the classroom
Use of direct strategies training (grouping) in the classroom
Administrators and teachers interested in incorporating training procedures and materials into regular curriculum
Provision of guidelines for strategies training
100
75
50
25
0
St. Paul Schools Responsibility (%)
Exploration
Development and Demonstration
Adoption
Major realm of this program.

Figure 1. Conceptual display of educational research and development utilized in this project. (Adapted from Moores, 1971; p. 7).

The major thrust of the present program was conceived as comprising primarily development and demonstration activities.

General Description of Instructional Approach

It seems that children learn both basic and advanced skills more rapidly when they are taught how to learn, as opposed to merely being given drill and practice on what they are to learn. Teaching a child how to learn involves teaching him to use appropriate learning processes and strategies. Although such process approaches are becoming more and more frequently recommended and used with normal children (e.g., set theory in new math and rule learning in phonics), the educable mentally retarded child is often assumed to be unable to utilize such a process-approach to learning. For example, even though a phonics approach is often used to teach writing to retarded children, the processes or rules for making this phonics-learning easier are usually not made explicit.

The technique of the summer program was to explicitly emphasize learning processes and strategies for learning in teaching basic skills to mentally retarded children. The daily instructional program for each child included four components: (1) reading; (2) arithmetic; (3) acquisition of functional vocabulary; and, (4) strategy (process) training. The teaching of strategies for organizing and remembering was one of the four components of the program as well as a method of instruction in each of the other components.

Pre-service and In-service Education

The pre-service training program provided an introduction to the approaches utilized in teaching reading, mathematics, vocabulary, and learning strategies. The package of vocabulary lessons to be used was presented, together with the basic reading and mathematics materials. Explanation was provided concerning the relationships among the reading, arithmetic, vocabulary and strategy-training components of the program, emphasizing the "process-approach" which was the central, unifying idea of the program. In the pre-service training, lecture and small-group conferences were utilized. The pre-service training was jointly planned and conducted by personnel of the St. Paul Schools and the consultants from the Research, Development and Demonstration Center.

In-service training was continuous with the instruction in the classroom. The consultants engaged in instructional activities with the teachers and trained the teachers to develop an awareness of the strategies necessary for optimum development of reading, mathematics and vocabulary skills. Based on the notion that researchers are limited in their daily contact with the children they are concerned with, and on the fact that teachers in the field could significantly enhance the researchers' understanding of teaching procedures and feasibility problems (See Figure 1), the following procedure was employed:

A group of five lead teachers was trained in the use of learning strategies prior to the summer program. In two cases, these

lead teachers were consultants on strategies who had had classroom experience, while the other three were experienced teachers with high proficiency in specific academic areas, who had utilized a strategies approach in their classrooms in earlier studies. These teachers consulted with the coordinators and chief consultant to plan specific training strategies for use in the classrooms. The lead teachers then met with the classroom teachers to explain the new lessons, and arranged to lead the first several activities in the classroom while the teachers observed. The classroom teachers then assumed the teaching role for the duration of the lesson plan (ranging in time from 2-3 days to 3-4 weeks), while the lead teachers observed and fed back their suggestions. Ongoing consultation at all levels assured useful feedback for both the teachers and the researchers involved.

A Strategy Defined[1]

The use of a processing approach to train educationally handicapped children to use strategies for learning constituted the instructional emphasis in this program. A conceptual definition of a strategy (below) was provided for the teachers during the preservice workshops:

"A strategy is a regularity in learning behavior which will insure that a concept and other kinds of meaningful associations will be attained quickly and with few errors, and which will minimize the strain on a child's memory capacity. By using a strategy for learning, the child will learn material faster and remember it better. Without strategies learning will be slower, require more repetitions, and

produce less recall of the classroom task. 'Normal' children seem to develop strategies with ease. The 'retarded' child may need to be directly taught what a strategy is and how it can help him remember."

Instructional Objectives

1. Children who attend five of the six weeks of the summer program (83% of the time) will achieve a minimum of 1.5 mo. growth in reading, as measured by standardized tests.

2. Children who attend five of the six weeks will achieve a minimum of 1.5 mo. growth in arithmetic, as measured by standardized tests.

3. Children who attend five of the six weeks will achieve a significant gain in vocabulary, as measured by tests of the vocabulary taught and/or a standardized test.

4. Children who attend five of the six weeks will show a significant improvement in the organizational strategies they use, indicated by assessments previously developed by the instructional staff.

Specific Description of Instructional Approaches

Because of the novelty of the strategies approach to learning, teachers were designated as either reading or math specialists according to their experience and preference. In this way each teacher was required to apply her knowledge of learning strategies to only one content area. Teachers were teamed so that each one worked with two classes of children, with a change of classes at mid-morning. Thus, each reading teacher taught two classes and each math teacher did likewise. In this way an intensive effort to integrate the strategies approach with academic material was facilitated.

1. Reading: All children were placed in a programmed series (BRL-Sullivan) in reading, according to their assessed level of performance. One half hour each day was spent on pre-teaching activities and in-book work in the BRL workbooks. Preteaching included phonics training and increasingly related grouping strategies to the classroom work.
2. Math: Silver-Burdett math texts were selected as the core math curriculum. Children were given training in computational skills for about one-half hour daily. Conceptual vocabulary lessons and relations between math-centered activities were also provided as both supplementary and complementary classroom activities (see Vocabulary description below).
3. Vocabulary: Daily lessons to enhance the child's oral vocabulary related to time concepts and measurement concepts were developed and presented in the classroom for about one-half hour each day. Integral to each lesson were audio tape-recorded presentations and picture-books utilizing elaborative contexts and relational organizing for improved comprehension and retention of the selected vocabulary items. Computational exercises were developed to encourage functional usage of the words and concepts presented.
4. Strategies training: Specific, direct training in the generation and utilization of learning strategies was included in each child's day for about one-half hour. This training included three basic strategies, which were adapted for use in each class according to the children's ability level and the relevance

of the strategy to the classroom curriculum. The strategies included were:

A. Strategies based on seeking and using associative relations between items and grouping them for improved learning and retention.

B. Elaboration strategies, in which new associations between disparate items were created as a way to remember otherwise ungroupable information.

C. A verbal self-instruction strategy in which children were given a systematic plan for accomplishing a task, from telling himself what he is to do, to evaluating his own performance.

5. Extra Time: It was originally planned that the above instructional components would ultimately be interrelated by means of utilization of the strategies approach. However, the time expected to accomplish this was not available due to the unexpected requirement that all children be given both breakfast and a snack during the 8:30 to 11:30 instructional period. The time required for these meals and the 15-minute recess period provided for the children reduced the effective teaching time each day to two hours, instead of the expected three.

Evaluation Procedures

Standardized tests were used for pre- and posttesting of reading and math performance (Stanford Achievement Tests). Organizational strategies were assessed by means of pre- and posttesting with instruments developed by members of the staff (e.g., the SORTS test:

Riegel, 1972).

Vocabulary was assessed by pre- and posttesting with a standardized test (Peabody Picture Vocabulary Test) and criterion-referenced tests of specific vocabulary units taught.

Results

The mean age of the children attending the summer program was 115 months, with an average IQ of 70. Fifty per cent of the 118 children attended at least 80% of the time. Because the time required for testing significantly detracted from the actual teaching time available, it was decided to terminate pretesting in favor of increasing time in the classroom after three days. As a result, many children who did not attend during the first three days of the program were not pretested on these measures. Only children who have both pretest and posttest scores on these indices were included in the analysis.

Reading and Math Scores

Pretest scores on the standardized reading test (Stanford Achievement Battery) yielded a mean grade equivalent score of 1.82, and on the math subtest of 1.69. Table 1 presents these data along with the posttest means and gains scores. Repeated measures t tests were run to determine the significance of these gains.

Table 1. Mean grade-equivalent scores on Stanford Achievement Test reading and math subtests for children with both pretest and posttest scores, with mean gain in months and t values.

	Pretest	Posttest	Gains	t
Reading Mean Grade-equivalent score	1.82	1.98	1.57 mos.	3.03** (N=49)
Math Mean Grade-equivalent score	1.69	1.88	1.98 mos.	2.41* (N=45)

* $p < .05$

** $P < .01$

An additional set of data represents criterion-references gains in the actual reading series employed during the summer (Sullivan-BRL reading program). Of the 49 children for whom both pretest and post-test data are available, and who attended 80% of the time, gains of approximately two months were found. Table 2 includes the mean number of books successfully mastered at pretest and posttest, with gains represented in number of teaching months expected to achieve the observed results.

Table 2. Pretest and posttest BRL placement in books, with gains represented in months.

Pretest	Posttest	Gain
3.92	6.00	2.1 mos.

Vocabulary Scores.

The results of the tests related to specific vocabulary gains are presented in Table 3. Four clusters of objectives were evaluated in the time test. These clusters represent mastery of: factual knowledge about time, broad time concepts, duration of time, and time-telling. As can be seen, significant gains were found for 13 of 17 objectives, with the learners showing pre- to posttest improvement for nearly all of the items related to the first three clusters of objectives. Three of the four items on which significant gains were not found were from the time-telling cluster of objectives. However, due to the limited length of the program only minimal instruction was provided in time telling, with most of this instruction falling under math as opposed to vocabulary instruction.

Table 3. Time unit objectives, percentage of children passing each item on pretest and posttest, and Z tests of proportional differences.

Objective	Pretest Mastery (%)	Posttest Mastery (%)	Z
Names the 7 days of a week.	6	41	3.26**
States what day today is.	68	92	3.50**
States the correct year.	33	59	2.97**
Orders yesterday, today & tomorrow.	18	42	3.03**
Orders morning, afternoon & night.	48	70	1.81*
Differentiates noon from midnight.	90	96	1.03
Describes a calendar.	26	61	3.86**
Discriminates hands on clock.	43	63	2.20*
Identifies an hour as less than a day.	55	76	2.50*
States activities which last about 1 hour.	30	50	2.24*
Identifies a second as less than a minute.	41	65	2.56*
States activities which last about 1 second.	16	56	4.55**
Uses hour hand consistently correctly.	21	46	2.89**
Tells time to hour.	58	68	1.14
Tells time to half hour.	38	48	1.11
Tells time to quarter hour.	13	25	1.62
Tells time to 5 minutes.	10	26	2.36*

*$p < .05$
**$p < .01$

Because the vocabulary unit on the measurement of weight and length was not initiated until late in the summar program (fifth week), and because only about 30 children received this unit, significance such as that found with the time unit was not expected. Strong trends were observed in a pre-post comparison after only one week of instruction, with a higher percentage of children showing mastery of 9 of the 14 items. However, significant gains were found on only four items, related to the use of a ruler and the length of standard units (the foot and the inch).

The results of the Peabody Picture Vocabulary Test, given to children in classes using lessons from the vocabulary component for more than one week, are presented in Table 4. The two youngest classes were not included in this analysis due to the need for more basic remediation than was then available in the vocabulary packages. The gain of nearly two points which was found in the results of these analyses represents almost a four-month gain, according to normative data in the PPVT manual.

Table 4. Mean pretest, posttest and gain scores on the Peabody Picture Vocabulary Test, and repeated measures test of significance.

Pretest $\bar{X}$	Posttest $\bar{X}$	Gain	T
59.95	61.79	1.84	2.72*

*p < .01 (2-tailed test)

Organizational strategies. The SORTS test (Riegel, 1972) was administered as both a pretest and posttest measure of associative grouping skills and recall effectiveness. In an analysis of the kinds of grouping strategies employed by children for organizing a set of stimuli, four basic levels have been defined for comparison:

Level 1: Syncretic strategies. Grouping at this level reflects a general failure to generate relations between items on the basis of an attribute or set of attributes. Grouping items by their spatial contiguity ("because they were next to each other") or subordinating the sorting task to an unrelated manipulative operation ("I wanted to make a square with the picture") are examples of this level. Also included are instances of no strategy for grouping at all, such as the case of a subject simply pulling all items into a single pile or not moving them at all.

Level 2: Perceptual strategies. Groupings at this level were suggested by the results of Riegel's studies, in which a sizeable proportion of EMR subjects (approximately 30%) sorted items on the basis of characteristics of attributes related to color, shape or size. When color, for example, was introduced as an irrelevant attribute of the stimulus materials, younger children tended to sort items on that basis, rather than attending to more intrinsic characteristics of the items such as function or category membership (cf. Birch & Bortner, 1971; McGurk, 1972).

Level 3: Low Associative strategies. This level includes associations for which intrinsic or semantic attributes of the items constitute the basis for grouping. Such groupings as thematic collections (formed by creating a story about the items) and complexes (collections of items for which inter-item associations are formed, but for which no over-all defining attribute is available) are examples of level three strategies. Level 3 groupings often take the form of pairs of items, rather than more reductive 4-5 item groupings.

Level 4: Superordinate and categorical strategies. Groupings at this level include superordinate groupings in which all items in a group are subsumed under a single intrinsic attribute or attribute set. Examples of groupings at this level include groups based on items having similar function (e.g., they all are for eating; you can live in them) or on category membership (e.g., they are furniture).

Comparisons were made between percer age of children producing each of the four categories of grouping responses for pretest and posttest. Table 5 presents these data. Although trends were observed in the higher levels of grouping toward a greater percentage of associative sorters, the major finding was that proportionally fewer children generated no strategy at all for sorting the items (level 1; $Z = 2.25$, $p < .01$).

Table 5. Percentage of children sorting items at each level (N=34).

	Pretest	Posttest
Level 1	29	12
Level 2	47	59
Level 3	12	12
Level 4	12	17

This decrease in the least efficient sorting strategy production was accompanied by an increase in recall of the items sorted. An average increase of nearly one item was observed on the posttest (see Table 6), which was found to be a significant gain. Related to this increase in recall is the notion that a higher-level grouping (more associative) will be recalled more completely, once a single item from it has been remembered. Suggestive support for this was in fact found, in that significantly more items per grouping were recalled on the posttest (see Table 6).

Table 6. Recall scores
for Sort 3 of the SORTS test.

	Pretest	Posttest
Mean recall[a]	6.85	7.74
s.d.	3.10	3.18
Mean Items per grouping recalled[b]	1.96	2.77
s.d.	0.93	1.33

[a] $t = 2.02$ (33 d.f.), $p < .05$
[b] $t = 3.34$ (33 d.f.), $p < .01$

If it were the case that the groupings were in some way more salient to efficient recall, then clustering would also be expected to increase. That is, we would expect that as a grouping becomes effective for recall, not only will the grouping serve as a mediator for recalling its members, but the items within the grouping would be recalled contiguously. In fact, this was found to occur. While 8.8% of the subjects clustered their recall of items on the pretest, 26.5% did so on the posttest. This difference in proportions was highly significant ($Z = 3.695$, $p < .001$).

Category presentation. Following the Sort 3 posttest, the items were rearranged by the testers into conventional categories, and the children were asked to give their reasons as to why they thought the pictures were put together in that way. Recall was again requested, and clustering calculated on the basis of the examiner's groupings. The results of this testing revealed that the children were by and large able to discover associative relations between category items (85.3% identified level 3 or 4 relationships). In addition, the average

recall of this phase was 8.09 items, and 35% of the children clustered beyond chance according to the categorical organization presented. These data confirmed previous findings that, when trained to utilize grouping strategies, EMR children could both identify and understand organizational relations when they were presented (cf. Riegel, 1972; Riegel, Taylor, Clarren and Danner, 1972).

Summary of results

While the results of testing are reported only on children for whom both pretest and posttest data are available, and who attended eighty percent of the total instructional time, analyses were also made of all available data. The results of these analyses supported the direction of change reported above, but were not as conclusive. As expected, children who did not attend eighty percent of the time did not gain as much on any measure as those who attended regularly.

In terms of the stated objectives, the results are encouraging:

1. Reading: Children who attended five of the six weeks of the summer program achieved a gain of 1.57 months in reading, as measured by a standardized test.
2. Arithmetic: Children who attended five of the six weeks of the summer program achieved a gain of 1.98 months in arithmetic, as measured by a standardized test.
3. Vocabulary: Children who attended five of the six weeks of the summer program achieved a gain of

approximately four months, as measured by the Peabody Picture Vocabulary Test. Significantly greater proportions of children mastered items on a test of specific vocabulary objectives on the post-test than on the pretest.

4. Strategies: Although significant differences were not obtained on all strategies measures, recall of items presented in the associative grouping task increased, a sizeable proportion of the children no longer failed to generate a grouping strategy, and most children were able to discover meaningful relations between categorically presented materials. In addition, a significant increase in the percentage of children who used their grouping skills to good mnemonic effect (as indicated by clustering) was observed.

Discussion

It is encouraging to find that educationally handicapped children, particularly those identified as encountering difficulty even within their special classes, have shown gains in basic reading and math achievement tests equivalent to those expected for non-retarded children in the same amount of time. Further, the results of strategies utilization testing have indicated a significant decrease in the children's failure to generate an organizing strategy, with a corresponding increase in systematic learning behavior as reflected in recall organization.

This program has resulted in several positive outcomes from the perspective of educational research and development. Procedures for integrating a processing approach to learning with the curricular material used in both reading and arithmetic lessons were developed and tested in several classrooms. Responses from both teachers and children indicated that the procedures developed constituted a viable approach to training educationally handicapped children. For example, children working on phonetically regular words in the BRL workbooks were given pretraining activities in the grouping of words first by common letters, then by common sounds, and ultimately by suffix meanings and semantic category. Although the specific effects of these activities were not directly assessed, there was agreement among the teachers involved that the children had acquired a substantial conceptual understanding of relationships between words, and a systematic plan for relating new words to words they already knew.

Although the objectives of the summer program, in terms of measurement outcomes, were met and in some cases exceeded, there were gains observed in many children which are not represented in quantitative data. The effects of training some of the children to generate stories and/or pictures for associating stimuli which do not fit into categorical groups (i.e., to elaborate) were not tested, as this training was basically a pilot venture for the development of specific activities. Formal testing of the effects of such training will be undertaken during the 1973 school year. However, ten sequential training lessons were developed during the program, which have been highly useful in the subjective analysis of

children's associative difficulties and as the basis for potential remedial techniques.

The vocabulary training units, too, proved quite useful in classroom activities, both as primary teaching tools and as supplementary activities to other curricular offerings. Relational operations in terms of time units and measurement units were readily integrated with arithmetic computational skills, adding a dimension of verbalization and direct experience to the seatwork. In addition, children became more aware of the passage of time and its relation to planning and sequencing activities, such as what part of the day is best for certain activities, or about how long a particular activity would take to complete. A demonstration package of materials related to airports and conceptual relationships between airport-related objects was presented prior to a field trip to the Metropolitan Airport. Children were observed to use many of the terms introduced in this package, and to point out similarities and differences between different kinds of airplanes based on their appearance, name, and function.

Training in the use of a verbal plan for self-instruction was given in several classrooms. Children were presented with a four-step plan for (1) identifying objectives, (2) specifying how they were to meet them, (3) evaluating the results, and (4) reinforcing their efforts. This plan was then elicited and reinforced in a variety of specific task contexts. Younger children were observed to respond more enthusiastically in the activities, and to appear more self-assured and confident following this training, although assessment procedures

were not available to test this observation.

The R&D approach to classroom teaching or the classroom approach to education R&D? Earlier in this paper, a figure was presented (Figure 1) which described the interface between the researcher/developer and the educator as conceived in the present project. The results reported above are a direct outcome of this interface, and should be considered in the perspective of a cooperative, programmatic effort rather than simply as an accumulation of separate specific training and development activities. A consistent interaction between the researchers and the teachers involved in the project resulted in what we believe are far more relevant intervention techniques than perhaps either could have achieved alone. The approach to training children how to learn specific material appears to be functional both for the teachers and for the children, and provides an alternative to current recommendations that handicapped children require much repetition in order to learn a particular set of materials.

The progressive exchange of responsibility represented in Figure 1 constitutes a systematic approach to the development of cooperative relationships between educational researchers and teachers, and insures careful evaluation of new materials and techniques prior to their adoption into regular curricular packages. Too often, for example, research on a given skill has been directly translated into a package of materials for dissemination to teachers without the kinds of inclass evaluation and teacher feedback necessary to account

for the classroom context or the specific characteristics of the learners. The three points of exchange, noted in Figure 1 as the "Major realm of this program" provide just this kind of evaluative feedback, and have been extremely helpful to the writers in identifying potential inefficiencies in development planning.

In many ways, for example, the summer program was the turning point in our approach to vocabulary development. First, those of us at the RD&D Center came to the realization that the schools were in need of an organized curricular approach to vocabulary, rather than a program for the general development of vocabulary. Thus, these activities in the areas of time and measurement became the foundation for the Math Vocabulary Program (cf. Taylor, Thurlow & Turnure, 1973). Second, this summer program brought us to the realization that vocabulary development does not occur overnight, and also that the entry level of the children is a necessary factor in planning a program of vocabulary development for them. Thus, the Math Vocabulary Program now includes two levels of instruction (pre-primary and primary). The meaning of key words or concepts within a level of instruction is now developed more slowly, and through systematic re-presentations of these words the "growth of meaning" is more likely to occur.

Limitations of the program

Several limitations to the integration of the various activities utilized in the program were noted. The first, relating to available teaching time after breakfast and snacks have been distributed, has

already been mentioned. The second was a persistent problem which affected the teachers' daily lessons plans. In an effort to train teachers in a relatively new approach to understanding children's learning problems, a great deal of time is required for observational feedback and specific, content-free teaching time. The strategies approach employed here required that children be trained directly in the use of associative procedures and memorization skills. Such training often must be conducted using materials (e.g., pictures) which are not directly applicable to curricular areas such as reading or arithmetic. However, in a program which states as its objective a six-week gain in each of these academic areas, limitations on the degree to which a strategies approach can be implemented are unavoidable. Teachers felt a great deal of pressure to show gains in reading and math, and consequently spent much teaching time in traditional textbook activities. While it is not our purpose to criticize the textbook appraoch, it was felt that some of the potential benefits of the strategies approach were lost due to academic pressures. We would recommend, should such a program be conducted in the future, that academic objectives be limited to either reading or math, but not both, so that teachers and consultants will be freed to develop better integrated and more systematic training procedures as a team. Fractionation of effort would thus be avoided, and efforts could be concentrated on the solution to some of the more persistent learning and retention problems of educationally handicapped children.

Footnotes

[1]Adapted from Bruner, Goodnow & Austin, A Study in Thinking, 1956, p. 54.

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